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### ARTICLE

# Opportunities for Managing Human Capital in University Spin-offs. A Dynamic Analysis

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### Abstract

Creating university spin-offs (USOs) should be one of the cornerstones of a country's business development. Yet a number of studies have identified two factors that limit their growth: access to funding difficulties and a lack of management skills among entrepreneurial teams. In order to identify potential solutions for the latter of those factors, an analysis was performed to determine how the implementation of certain human resources policies affects the creation and retention of

human capital in USOs. If successfully implemented, such policies can contribute to a more efficient management of the market value of such organisations. So, after diagnosing what the human capital component of Spanish USOs is considered to be, a causal analysis was performed. The approach taken to the analysis was that acquiring and retaining human capital is a strategic problem for such organisations. The outcome of the analysis is a series of policy proposals that, taking account of the differential characteristics of USOs, aim to foster the recruitment, development and retention of human capital as the basis of such organisations' business competitiveness.

### Keywords

human capital; spin-off; human resources management; entrepreneurship; strategic management

## *Oportunidades de la gestión del capital humano en las spin-offs universitarias. Un análisis dinámico*

### *Resumen*

*La creación de spin-offs universitarias debería constituir uno de los pilares sobre los que sustentar el desarrollo del tejido empresarial de un país. Sin embargo, de los análisis realizados se desprenden dos factores que limitan su crecimiento: las dificultades de acceso a fuentes de financiación y la falta de habilidades de gestión del equipo emprendedor. Para poder contribuir a solucionar la segunda de las dificultades detectadas, se ha realizado un análisis destinado a explicar cómo la implantación de determinadas políticas de recursos humanos puede afectar a la creación y mantenimiento del capital humano en las spin-offs universitarias, y con ello contribuir a una gestión más eficiente de su valor en el mercado. A partir del diagnóstico de cuál es la consideración del capital humano en las spin-offs españolas, se ha desarrollado un análisis causal que plantea la adquisición y mantenimiento del capital humano como un dilema estratégico para este tipo de organizaciones. Del análisis realizado se han derivado una serie de políticas propuestas que, teniendo en cuenta las características diferenciales de las spin-offs universitarias, están encaminadas a favorecer la captación, el desarrollo y retención de su capital humano como base de su competitividad empresarial*

### *Palabras clave*

*capital humano, spin-off, recursos humanos, emprendimiento, dirección estratégica*

## 1. Introduction

The creation of new businesses generally has a number of positive effects such as job generation, economic and social development and innovation, among others. Likewise, businesses created within a university environment, which are known as 'university or academic spin-offs', have several advantages over other, more traditional technology transfer mechanisms such as patents. Businesses of this type are usually located close to where they are created, thus fostering local economic development (Zucker et al., 1998); they generate revenue that benefits both the founders and the host universities (Bray & Lee, 2000); they drive changes in institutions (Brooks & Randazzese, 1998); and they increase the level of interaction between universities and their social environments (Dorfman, 1983). In addition, spin-offs provide alternative job opportunities for staff working in public research

centres, who often find it impossible to further their scientific careers in such organisations, or even to find a job in the first place (Hernández et al., 2003).

Most university spin-offs (USOs) take the form of small technology consultancies. Attracting and retaining human capital, which is represented by the stock of senior professionals in them, constitutes the cornerstone of their competitive edge (Calvo, 2011). However, managing such human capital is complex and requires skills that entrepreneurs do not usually have.

This article therefore intends to answer the question that managers of USOs so often ask: What differential policies for human resources should be taken into account in organisations of this type in order to attract and retain the value of their human capital? Two assumptions serve as the starting point: a) a USO's competitive edge stems from the recruitment, development and retention of its human capital, and b) a USO's human capital management is not comparable to that of other businesses. Two differential factors of USOs that should be taken into account are their small size and their proximity to universities.

This article is divided into four sections: the first is this introduction; the second is an initial diagnosis that allows the current situation of USOs' human capital to be determined; based on that diagnosis and a prior causal analysis, the third is a series of policy proposals regarding the recruitment, development and retention of human capital in organisations of this type, all of which are aimed at fostering their market competitiveness; the fourth and final section provides the main conclusions drawn from the study.

## 2. Initial diagnosis of Spanish USOs' human capital

While there is no commonly accepted way of defining the concept of human capital, most definitions point to a set of distinctive basic competencies of an intangible nature (Bueno Campos, 1998) that are capable of providing a durable competitive edge (Cañibano et al., 1999).

If human capital is considered to be the stock of individual knowledge that experienced employees of an organisation possess (Bontis et al., 2000), then it is possible to assert that businesses created within a university context have a significant human capital component (Correa, 2009). In Spain, USOs are mainly created on the basis of tacit, uncodified knowledge; it is the entrepreneurs' personal know-how that underpins the potential development of such businesses (Rodeiro et al., 2008).

As a framework of reference for the analysis, some data relating to general aspects of Spanish USOs will be shown, as will others relating to their human capital. For that purpose, the studies by Rodeiro et al. (2008) and Ortín et al. (2007) were taken as the reference. Respectively, those studies analysed a total of 72 and 70 USOs created in Spain (Table 1).

Table 1. General characteristics of USOs and their human capital

<i>General characteristics of USOs</i>			
		Ortín et al. (2007)	Rodeiro et al. (2008)
Mean number of employees		8.34	8.01
Sales/Mean turnover volume (Euros)		16,737,022	291,972
Mean balance figure		832,967	378,779
<i>Characteristics of technology inventors</i>			
Mean number of people that develop technology		Not available	4.5
Source knowledge area	Technical teaching	Not available	50%
	Experimental sciences	Not available	25%
	Health sciences	Not available	9.2%
Percentage of inventors who are also business founders		Not available	80%
Role of the inventor in the business	Advisor/consultant	7%	33%
	Director	43%	32%
	Managing director	Not available	17%
<i>Characteristics of business founders</i>			
Mean number of people that set up a business		2.66	3.6
Mean age (years)		39.2	33.8
Percentage of doctors		20%	20%
Percentage of businesses having a founder with prior business experience in the USO sector		57.7%	59.7%
Percentage of businesses having a founder with prior experience of setting up businesses		26%	32%
Main reason for setting up a business		Identifying a business opportunity	Identifying a business opportunity
Main barrier to growth		Access to financial resources	Access to financial resources

Source: own elaboration based on Ortín et al. (2007) and Rodeiro et al. (2008)

One of the conclusions that can be drawn from the above data is that the majority of the creators of technology exploited by USOs actually plays an active role in them. The study by Rodeiro et al. (2008) shows that 50% of the people that develop a technology eventually become directors of their respective businesses, whereas 33% become consultants. The study by Ortín et al. (2007) shows that 43% of the founders eventually become directors, whereas 7% become consultants. This means that the characteristics of the 'inventors' have a major impact on a business and its management.

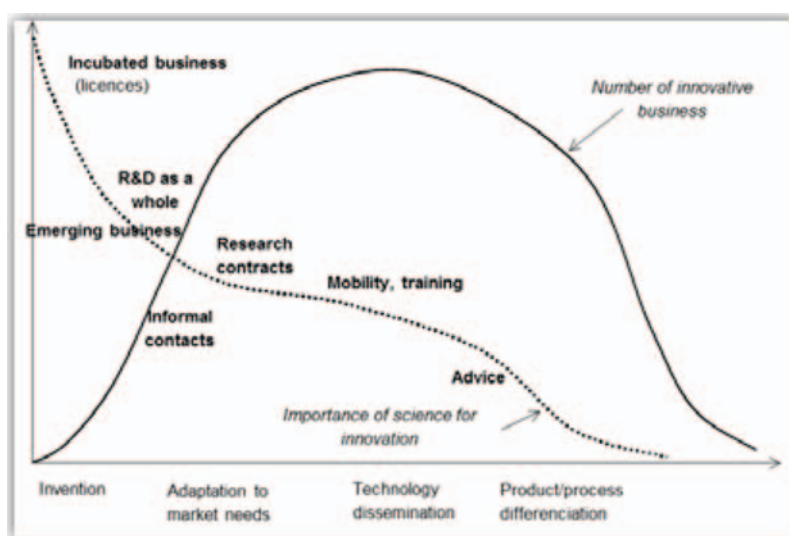
The mean age of USO founders is below 40 (the mean age of entrepreneurs in Spain is 41, GEM, 2010), and 'Identifying a business opportunity' is the main reason for creating them. It is also possible to see that the entrepreneur group is highly qualified; indeed, 20% are doctors.

As the main factors limiting the growth of USOs, the literature points to a shortage of financial resources (Tobar, 2004; Sbragia & Ozório, 2004; Díaz, 2004) and the entrepreneurs' lack of management skills (Bruderl et al., 1992; Lee & Tsang, 2001; Rodeiro & Calvo, 2011).

The latter of those factors, the lack of management skills, is connected with businesses' intellectual capital creation (Madrigal Torres, 2009); entrepreneurs of such businesses also highlight it as one of the main problems that they encounter (Rodeiro et al., 2008). The people that create USOs usually have a high level of technical skills, but they do not have the required training in the field of management (Ortín et al., 2007).

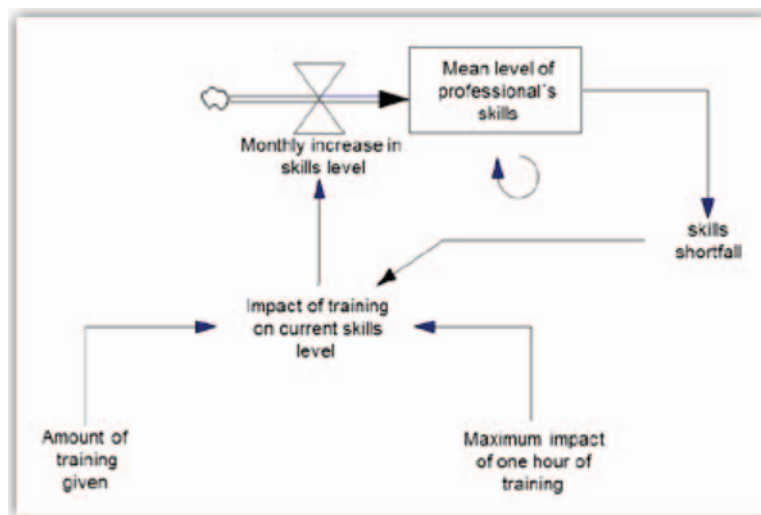
This lack of university entrepreneurs' management skills may have direct consequences, such as poor work team coordination, the inability to meet deadlines according to the business plan, minimal market orientation of technologies and products created, small networks of contacts and inadequate business management. Consequently, many USOs may not achieve any considerable growth (Harrison & Leitch, 2005; Lockett et al., 2005). The failure of such businesses is often due to management team problems, basically because managing a business is very different from managing a research laboratory (Timmons, 1994). In order to improve business management, both know-how and know-who are vital (Mustar, 1997). Problems such as these, which USOs have to grapple with, may go some way to explaining why their growth has slowed down (Chiesa & Piccaluga, 2000; Cardozo & Engleman, 2004; Harrison & Leitch, 2005).

Moreover, the institutional framework does not appear to be adequate in terms of ensuring a smooth university-business relationship that is capable of generating USOs, or indeed of achieving the virtual organisation flexibility that has become the norm in business relationships (Ritter & Gemünden, 2003; Hakansson, 1982). The financial results of patent commercialisation, commissioned research or collaboration agreements between research groups or institutes and business organisation do not manage to achieve what is expected from a process of networked business value generation (Pérez-Astray & Calvo, 2011). Seen from an innovation lifecycle approach (Figure 1), such a poor impact (Pekerman & Walsh, 2007) may be explained by the type of know-how that science usually offers, and by the demand for such know-how in a business's innovation cycle.



This situation suggests that human capital management in USOs is of paramount importance. Rather than by their investment in assets, the value of USOs is mainly determined by the perceived value of their professionals' know-how and experience. In this respect, the role of training (formal and informal) in the value creation processes of USOs is fundamental. From a dynamic viewpoint, it is worth bearing in mind the approach put forward by Warren (2000), who asserts that, while training programmes increase the development of skills, oversight and a lack of continuous reinforcement are mechanisms that lower the level already achieved (Figure 2). This feedback loop allows a dynamic balance to be maintained with regard to the skills levels of professionals in businesses that invest in continuing development, a key aspect of the USO value chain.

Figure 2. Limits on growth of professional skills.



Source: adapted from Warren (2000)

The analysis performed makes it possible to assert that human capital constitutes the cornerstone of USOs when it comes to generating their competitive edge. Consequently, its absence is one of their main barriers to growth. So, in the authors' opinion, it is necessary to identify management practices that allow such organisations' strategies to focus on creating and retaining their human capital.

### 3. Selection of best practices and their relationship to human capital generation

#### 3.1. Causal and sensitivity analysis

For more than two decades, theoreticians of strategic thinking have considered the impact of certain human resources practices on organisational strategy. Various studies support the positive relationship between certain human resources practices and better organisational performance (Kaufman, 1992; Terpstra & Rozell, 1993; Bartel, 1994). Taking that approach as a reference, and on the basis of the

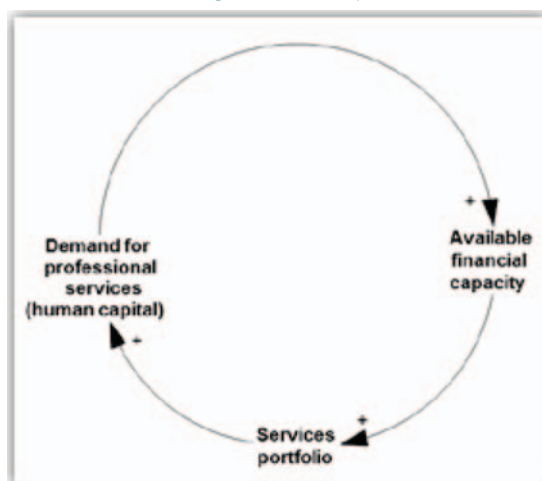


specific dynamics of human resources management in USOs (Calvo, 2011; Stearman, 2000), a series of policy proposals regarding the recruitment, development and retention of human capital in organisations of this type have been made, all of which aim to foster their market competitiveness.

Regarding the approach taken to the analysis in this study, the strategic aspect governing the survival of USOs is their capacity to acquire and retain human capital that the market requires, in the form of their stock of professionals or know-how. In order to offer differential, innovative services, such businesses must allocate resources to training their professionals, not only to increase and enhance their technical know-how, but also to develop their business skills. At the same time, owing to their small size and minimal financial resources, they have to make a turnover in the short term in order to survive. Professionals forming part of such organisations, whose salaries are often lower than average for the sector, value the ability to learn and the employability aspects that organisations of this type can offer them. However, trying to combine short-term survival with medium-term growth potential through investment in Research, Development & Innovation (RD&I) is tough and often thwarts their professional expectations. They leave as a result, and this leads to an intellectual decapitalisation of such businesses.

Given that the situation was found to be a dynamic problem, the authors identified a series of feedback loops to help them take an in-depth look at the strategic problem posed (Figure 3).

Figure 3. Basic loop

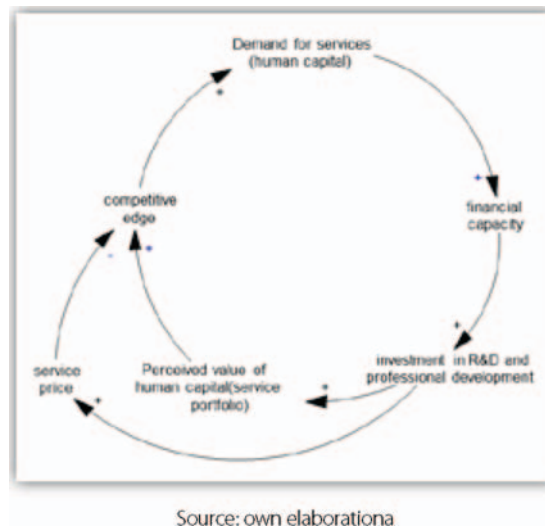


Source: own elaboration

External demand for services determines the financial capacity of a business and allows it to create its portfolio of professional services, linked to the training of its human capital (Figure 4). If demand goes up and the business manages its professionals' knowledge well, then that will lead to a USO's growth in the long term. The greater the human capital offered by a USO, the greater the client's perceived competitive advantage of the business. This will lead to a higher demand for services, which in turn will strengthen the business-client relationship and foster its growth (positive loop).

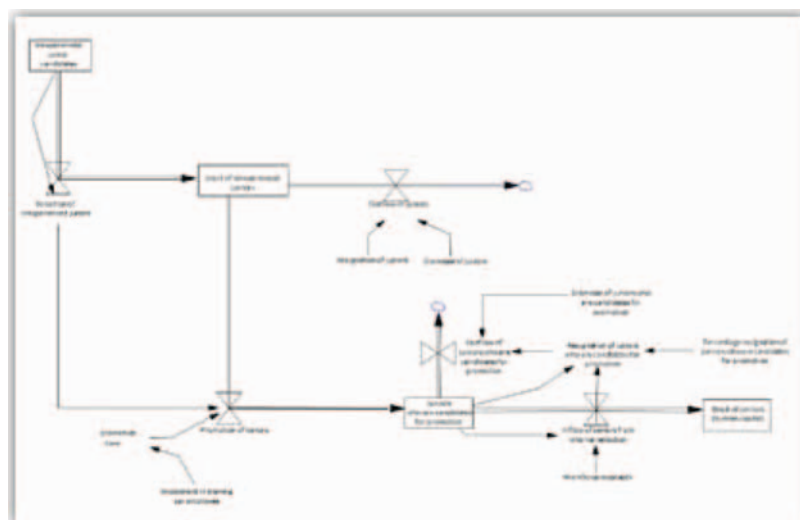
However, creating a greater stock of human capital, which requires bigger investment in R&D and professional development, will increase the internal cost of services. This will lead to higher prices, which in turn will weaken future demand for services (negative loop).

Figure 4. Competitive edge loop



On the basis of this prior causal analysis, managed with a focus group formed by 16 human capital management experts in professional service businesses, a flow model was designed. This flow model enables an evaluation of the relationship between investment in training, the existence of human capital (number of senior professionals recruited through internal selection processes) and an organisation's growth (retaining the number of senior professionals over time). A constant factor to bear in mind is that USOs usually take on inexperienced junior members of staff and train them internally, but that during the process, many of those professionals resign from the organisation, thus rendering the process of skilled human capital management and retention more difficult (Figure 5).

Figure 5. Flow of human capital



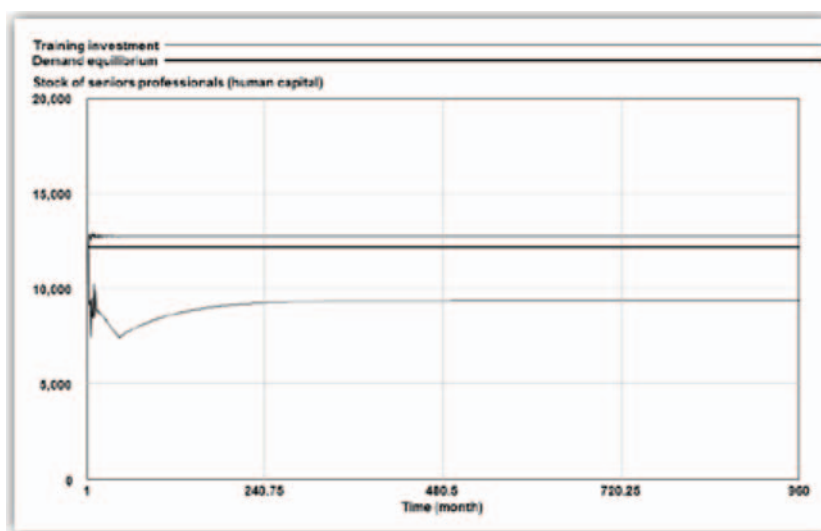
If account is taken of the fact that consolidating the professionals' experience takes time, then the main impact of greater investment in training will be a shortening of the time in which inexperienced



professionals (genuinely inexperienced junior members of staff) will get the required promotion to join a business's team of senior professionals, on the assumption that the demand for projects is sufficient to generate vacancies on that team. Also taking account of the fact that businesses value the existence of human capital in organisations of this type, having a workforce of senior professionals will provide a USO with a competitive edge over other businesses, which will foster its growth.

Thus, considering a scenario of demand of professional services equilibrium, the sensitivity analysis (Figure 6) shows that investment in training becomes a point of leverage for the growth of organisations of this type. This is so because an increase in investment in training per employee above the sector's mean increases the stock of senior professionals, which allows an organisation to adapt to the requirements of demand (conversely, investment in training below the sector's mean has the opposite effect).

**Figure 6.** Sensitivity of training investment in the stock of senior professionals (human capital)



Source: own elaboration

However, the difficult balance between the flow of professionals and demand for projects makes it essential to define a series of specific human resources policies for USOs, the aim of which is to align the internal capacities of an organisation with the intellectual capital demand of the market.

### 3.2. Human capital recruitment and selection

Thanks to their privileged relationship with niche universities and research groups, USOs are able to lower the costs (Fama & Jensen, 1983) associated with recruiting and selecting human capital. From this perspective, USO managers have privileged access to specialised human capital with high potential, since they can take advantage of the information asymmetry (Eisendhardt, 1989; Fama & Jensen, 1983) that prior knowledge of the candidates —through their participation in academic activities— provides them with. Likewise, they may be able to maintain differential recruitment and selection advantages by entering into favourable agreements with academic institutions.

### 3.2.1. Access to different knowledge areas

USOs can recruit employees with different skills from different areas. The directors of such businesses have the direct opportunity to recruit staff from the departments in which a technology has been developed. They can also recruit staff from other knowledge areas, which will facilitate the future growth and development of such organisations.

RECOMMENDATIONS and POLICIES: USOs should approach university graduates and researchers in knowledge areas that are different from those of their founders. In this respect, including people with profiles that are more entrepreneurial, such as graduates or students on master's degree or postgraduate courses in Business Administration and Management, would allow a USO's lack of business skills and knowledge of the market to be overcome. Other studies such as Labour Relations, Languages and International Relations could be sources of qualified staff, who would be able to collaborate on a USO's management tasks or internationalisation processes.

### 3.2.2. Knowledge retention

USOs originate from certain research groups and departments of a university, so they know their members directly. This situation is maintained over time because many of their founders keep in touch with the departments in which a technology has been developed. In addition, USO founders often use their network of contacts within a university to obtain information about students or researchers in other departments. Therefore, such links with source institutions mean that USOs have prior knowledge of the potential candidates that it might want to employ and are able to identify which of them could increase their stock of human capital in the future. Thus, when it comes to taking on new staff, one of the major problems is eliminated: information asymmetry.

RECOMMENDATIONS and POLICIES: For USOs to continue counting on universities as potential sources of employees, who are known directly or indirectly, such businesses and their directors should maintain links with source institutions.

In this respect, the proposal is to strengthen the use of shared facilities, the temporary employment of staff and the promotion of cooperation agreements.

### 3.2.3. Flexible employment

By temporarily employing students and researchers, USOs are able to find out about the real skills of university members employed in them. It also allows a degree of labour flexibility and certain advantages with regard to employing people in the future. Currently, the Torres Quevedo programme offers three-year subsidies when R&D staff (doctoral students and technologists) are employed by businesses, technology centres, entrepreneurial associations and science and technology parks.

The aim of the programme is to stimulate the supply and demand for researchers, and to foster the transfer of R&D outcomes and their implementation in the productive system.

RECOMMENDATIONS and POLICIES: To strengthen the use of programmes of this type, which allow doctoral students to be employed to undertake internships in businesses. To do that, it will be necessary to increase the dissemination of such programmes and to highlight the positive outcomes obtained from these or earlier ones.<sup>1</sup>

### 3.3. Human capital development

In the previous causal analysis, the problem posed by either investing in professional development (investment connected with R&D) or allocating the selected professionals' time to the commercial exploitation of already acquired know-how determines the strategic importance of this policy.

The policy proposal involves maintaining strategic alliances with research groups and university teaching staff. Relationships with research groups will allow USOs to access one-off elements of already developed know-how to exploit them in the market, shaping a make-buy mixed human resources system (Miles & Show, 1984) that is favourable from a competitive viewpoint.

Relationships with university lecturers will enable USOs to benefit from the specialised training of their professionals at a lower cost than on the open market.

#### 3.3.1. Greater time and financial constraints

The literature points out that financial constraints are some of the main problems that USOs face, and this has repercussions for the development of their human capital. USOs cannot afford to maintain permanent R&D departments. They do not have the financial capacity to do so, in the early years at least. Yet, not allocating time and resources to training their professionals may give rise to a moral hazard problem (Eisendhardt, 1989; Fama & Jensen, 1983). Employees with knowledge-worker profiles take on greater workloads in exchange for lower pay in the hope of furthering their development and innovative capabilities. Yet USOs wholly allocate their staff to the commercial exploitation of their stock of know-how. In the medium term, this policy will lead junior professionals, who are candidates for promotion, to resign, with the ensuing intellectual decapitalisation of such businesses and loss of competitiveness. In addition, USOs have to cope with a constant re-adaptation of their capacities in their early years of existence, when many of them are still positioning themselves in the market. This gives rise to time constraints for training their staff; most employees spend most of their time on day-to-day operations and short-term activities.

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1. The IDE (incorporation of doctors into enterprises) programme ran from 1997 to 2001, and was then replaced by the Torres Quevedo programme for doctors and technologists. According to the evaluations carried out, the impact of the programme was positive (Sanz Menéndez, Cruz Castro & Aja, 2004). In fact, several years after forming part of it, six of the 10 doctors still had stable employment in the same business.

RECOMMENDATIONS and POLICIES: To ensure that the development of USOs' human capital fits into their time and financial constraints, such organisations will have to carry out a prior selection of their staff, by taking advantage of their privileged relationships with the university community. Moreover, strategic alliances with research groups will allow USOs to access one-off elements of already developed know-how to exploit them in the market, shaping a make-buy mixed human resources system that is favourable from a competitive viewpoint. In addition, relationships with university lecturers will enable USOs to benefit from the specialised training of their professionals at a lower cost than on the open market.

### 3.4. Human capital retention

The retention of professionals in USOs is directly related to the fulfilment of their professional development expectations, to the consistency of selection and development policies, and to their pay (in relation to what they might be able to command in the market). When such employees leave, especially if that happens after they have been working for a USO for some time (senior professionals), it will lead to a loss of competitiveness stemming from the total non-recovery of the investment made in their training, a decline in its portfolio of commercial services linked to the stock of human capital, and to a loss of financial resources because money will have to be spent on selecting and training new professionals.

#### 3.4.1. Greater commitment

On many occasions, employees that join the workforce of USOs have a direct link with the founders or directors of such businesses and/or are entering into their first contract of employment. This means that they have a greater moral commitment to the business and to the people managing it.

RECOMMENDATIONS and POLICIES: USOs should create a formal commitment, binding on both parties, in the form of tie-in agreements, training commitments or confidentiality agreements (to keep research outcomes secret) in order to strengthen the commitment created during their foundation. Likewise, USOs should design policies to strengthen their employees' identification with the general business objectives. The purpose of doing so is to align the creation of specialised human capital with the needs of the market.

#### 3.4.2. Business growth potential

Since USOs are businesses that originate from universities, a high level of growth is expected from them. However, their growth is often moderate (OECD, 1998) and their impact on the economy is relatively low (Callan, 2001). If the growth, size, profits and products of such businesses are modest, then retaining their human capital will be more difficult. In contrast, if USOs expand their markets, then they will be in a better position to retain their employees.

RECOMMENDATIONS and POLICIES: USOs should pursue real growth, working in global markets that allow them to expand. In order to do so, it is vital for them not to limit themselves to consultancy activities alone. Rather, they should become the holders of technologies with direct applications in the market.

## 4. Conclusions

USOs need to maintain a degree of rationality and dynamic balance in the decisions they take on the use and management of their resources and capacities (Foss & Knudsen, 2003; Diedrickx & Cool, 1989; Amit & Schoemaker, 1993; Rumelt, 1984).

From a dynamic perspective, if USOs design their human resources practices to serve as the cornerstone of their competitive edge, then they will take decisions on which policies to implement in order to retain a certain level of human capital in their respective organisations.

Table 2. Human capital management in USOs

<i>Human capital management actions</i>	<i>Differential aspects of USOs</i>	<i>Policy proposals</i>
Recruitment and selection	<ul style="list-style-type: none"> <li>• Privileged access to specialised human capital (technical and entrepreneurial)</li> <li>• Information asymmetry</li> <li>• Favourable contractual relations (temporary employment and lower costs)</li> </ul>	<ul style="list-style-type: none"> <li>• Participation in academic activities</li> <li>• Recruitment of researchers from the same knowledge area or complementary areas</li> <li>• Employment of internship students</li> <li>• Participation in the Torres Quevedo programme</li> <li>• Dissemination of their activity and image among the university community</li> <li>• Demand for favourable contracting regulation of lecturers and researchers</li> </ul>
Development	<ul style="list-style-type: none"> <li>• Lack of financial capacity in development investment</li> <li>• Moral hazard problems</li> <li>• Speed and lower cost</li> </ul>	<ul style="list-style-type: none"> <li>• Strategic alliances with research groups</li> <li>• Training assignments awarded to university teaching staff</li> <li>• Occasional employment of researchers for business activities</li> <li>• Maintaining training links with source universities</li> </ul>
Retention	<ul style="list-style-type: none"> <li>• Greater commitment</li> <li>• Future employment</li> <li>• Growth potential</li> </ul>	<ul style="list-style-type: none"> <li>• Consistency of selection and development policies</li> <li>• Training assignments awarded to university teaching staff, in line with the needs identified</li> <li>• Systems for the explicit storage of know-how</li> <li>• Design of a framework of confidentiality in relation to the use of know-how</li> <li>• Incentive systems for training and participation in commercial objectives</li> <li>• Subsequent collaboration agreements with research groups and temporary employees</li> </ul>

The outcome of the analysis performed is a series of policy proposals that, taking account of the differential characteristics of USOs, aim to foster the recruitment, development and

retention of human capital. Making full use of the information asymmetry that knowing and having privileged access to valuable candidates (in terms of their know-how and potential) offers, fostering collaboration agreements with research groups and university teaching staff to stimulate the growth of their portfolio of services and the development of their professionals, and implementing retention mechanisms based on reducing moral hazard problems and promoting new collaboration agreements to increase relational capital are some of the measures proposed. This will allow the commercial activities and human capital development of such businesses to be aligned, which will help them to overcome the formulated strategic problem and foster their future growth (Table 2).

In the authors' opinion, this analysis represents a good starting point for future research into the strategic management of USOs, a field in which few studies have been undertaken.

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